

Pediatric Precision Sleep Network

U01MH136020

Presenter: Adriane Soehner, PhD, University of Pittsburgh School of Medicine

www.pediatricsleepnetwork.org

October 30, 2025



Agenda

- Our Team
- Project Overview
- Progress Updates, Successes, and Challenges
- Looking Forward

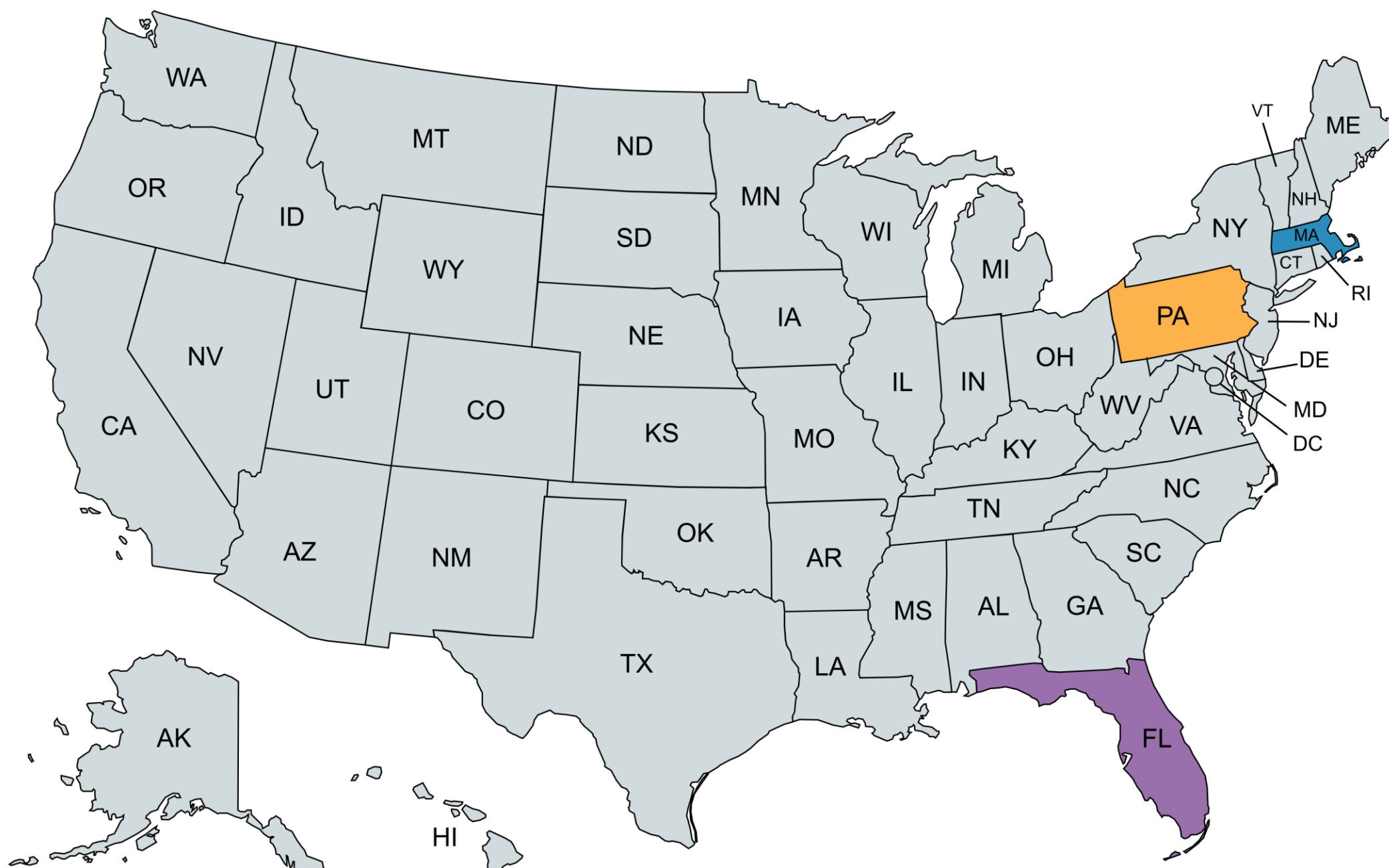
Pediatric Precision Sleep Network (PPSN)



A multi-site network that will leverage electronic health record data, the multidimensional sleep health framework, multimodal home sleep monitoring, and advanced computational methods to:

- a) establish **sleep signatures** in pediatric primary care patients
- b) use these signatures to predict mental health outcomes and
- c) develop low-burden and scalable risk stratification algorithms

PPSN Sites



Boston



**Boston Children's
Hospital**

Pittsburgh



**University of
Pittsburgh**

Miami



**Nicklaus
Children's
Hospital**



**Center for
Children and Families**

FLORIDA INTERNATIONAL UNIVERSITY

PPSN Principal Investigators



Adriane Soehner, PhD
M-PI (Pittsburgh Site)

University of Pittsburgh, Psychiatry
Pediatric Sleep & Mental Health



Maria Jalbrzikowski, PhD
M-PI (Boston Site)

Boston Children's Hospital,
Psychiatry & Behavioral Sciences
Neurodevelopment & Mental Health



Meredith Wallace, PhD
M-PI (Pittsburgh Site)

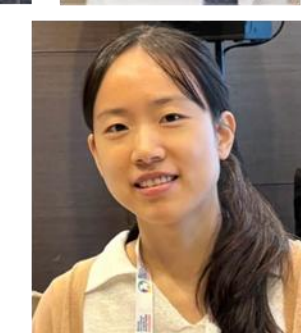
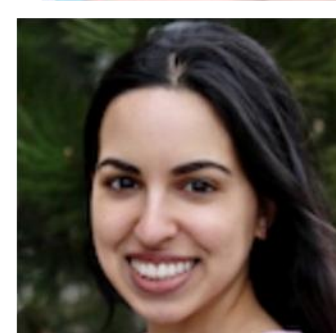
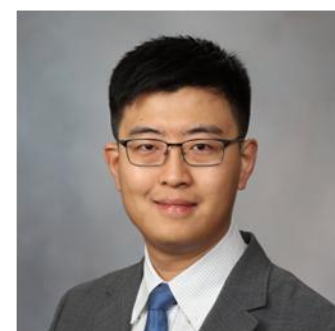
University of Pittsburgh, Psychiatry,
Biostatistics, & Statistics
Computational Methods



Dana McMakin, PhD
M-PI (Miami Site)

Florida International University,
Psychology
Pediatric Sleep & Mental Health

PPSN Team Members



Scientific Premise



- **Peri-adolescence** is a key window for early detection and prevention of transdiagnostic mental health conditions.
- Risk stratification models built on electronic health record data are emerging as powerful and practical tools in **pediatric primary care** however **modifiable risk factors** should be integrated.
- **Poor sleep health** is a common, causal, and modifiable transdiagnostic mental health risk factor.
- Over half of peri-adolescents experience unhealthy sleep patterns, and sleep problems during peri-adolescence prospectively predict negative mental health outcomes more strongly than at other times in development

Multidimensional Sleep Health in Adolescence



- Real life sleep problems in teens are not easily categorized into diagnoses
- Difficult to differentiate **normative versus at-risk** sleep patterns
- The **multidimensionality** and **multimodality** of sleep has led to inconsistencies regarding which features and modalities are critical for mental health screening

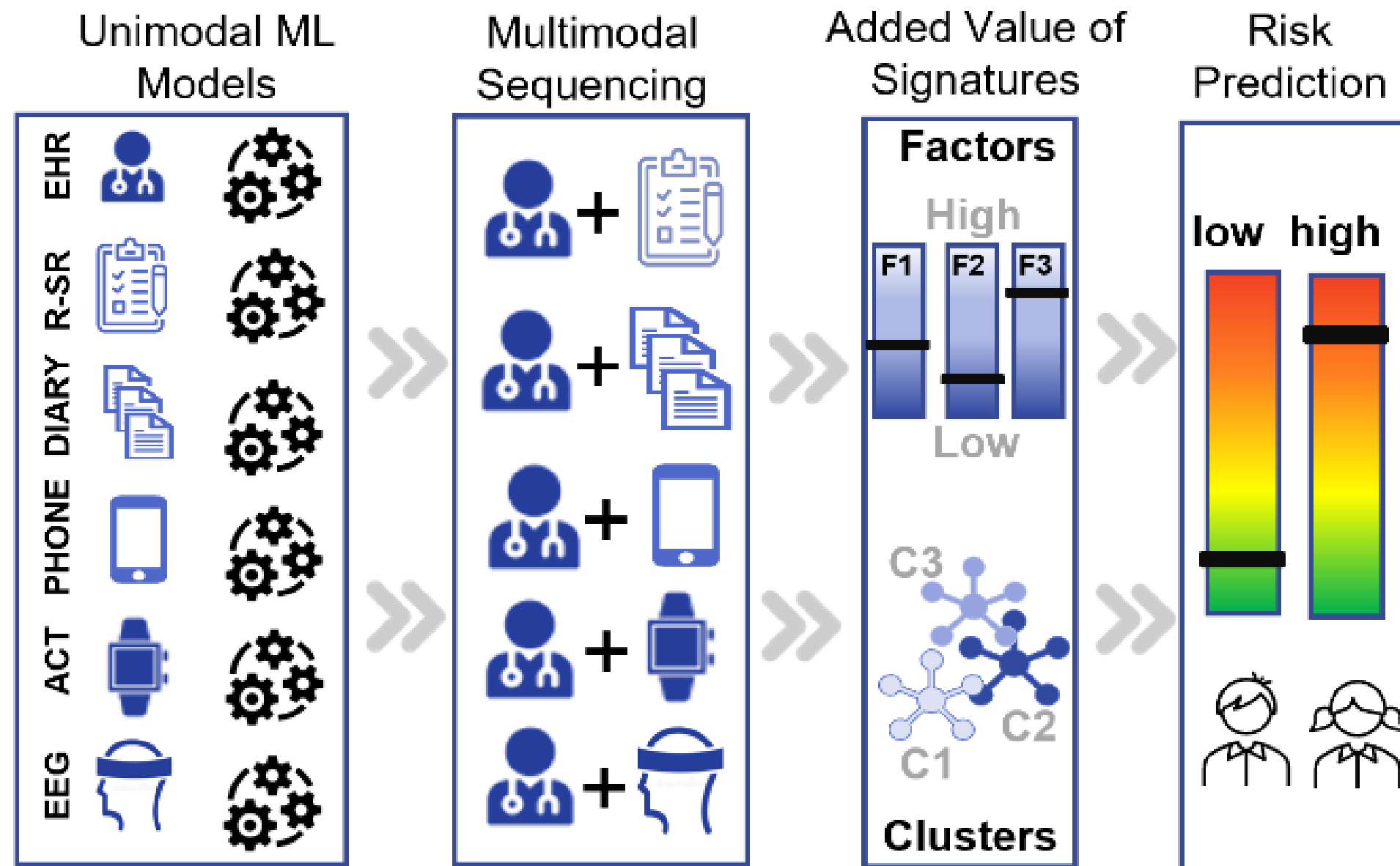


Develop Sleep Signatures (Aim 1)

Method	Description	Signature Extraction	Research Implications	Clinical Implications
Factor Analysis 	Identifies groups of variables that represent unmeasured latent factors	Composite score for a given factor indicates a youth's signature level	• Clarifies which sleep features are interrelated • Enhances rigor and reproducibility by guiding variable selection and establishing composite factor scores	Youth with adverse levels on one or more factors may require intervention
Cluster Analysis 	Identifies groups of people with similar multivariable patterns of sleep characteristics	Cluster membership indicates each youth's signature pattern	• Indicates common combinations of sleep patterns to be targeted in future studies • Patterns may have stronger associations with MH outcomes than individual features they comprise	Youth with an adverse pattern of features may require intervention

- **Sleep signatures** – within-person combinations of multiple sleep features – may better characterize the levels or pattern of a person’s sleep features.
- Sleep signatures can improve prediction of health outcomes and generate hypotheses for novel intervention targets

Mental Health Outcome Prediction (Aim 2)

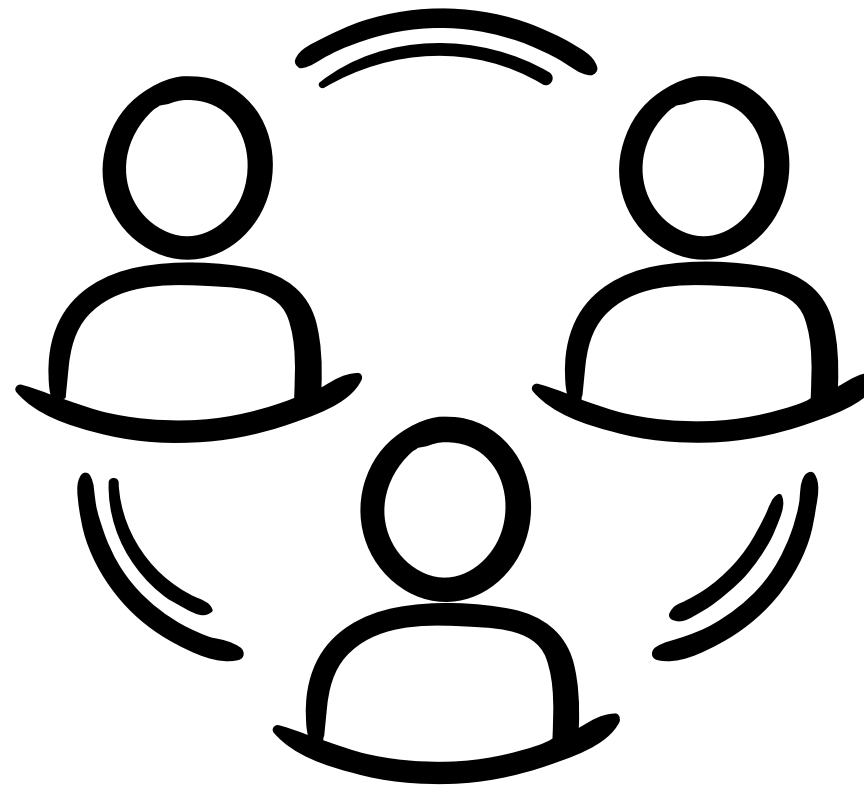


- **Multimodal** sleep assessment brings the challenge of identifying which modalities are needed for mental health outcome prediction.
- By incorporating multiple sleep modalities and signatures into **sequential risk stratification algorithms**, we can expand the capabilities of our algorithms to include risk stratification *as well as* insight into optimal sleep treatment.

PPSN Components



New Data Collection Study
(SleepLife)

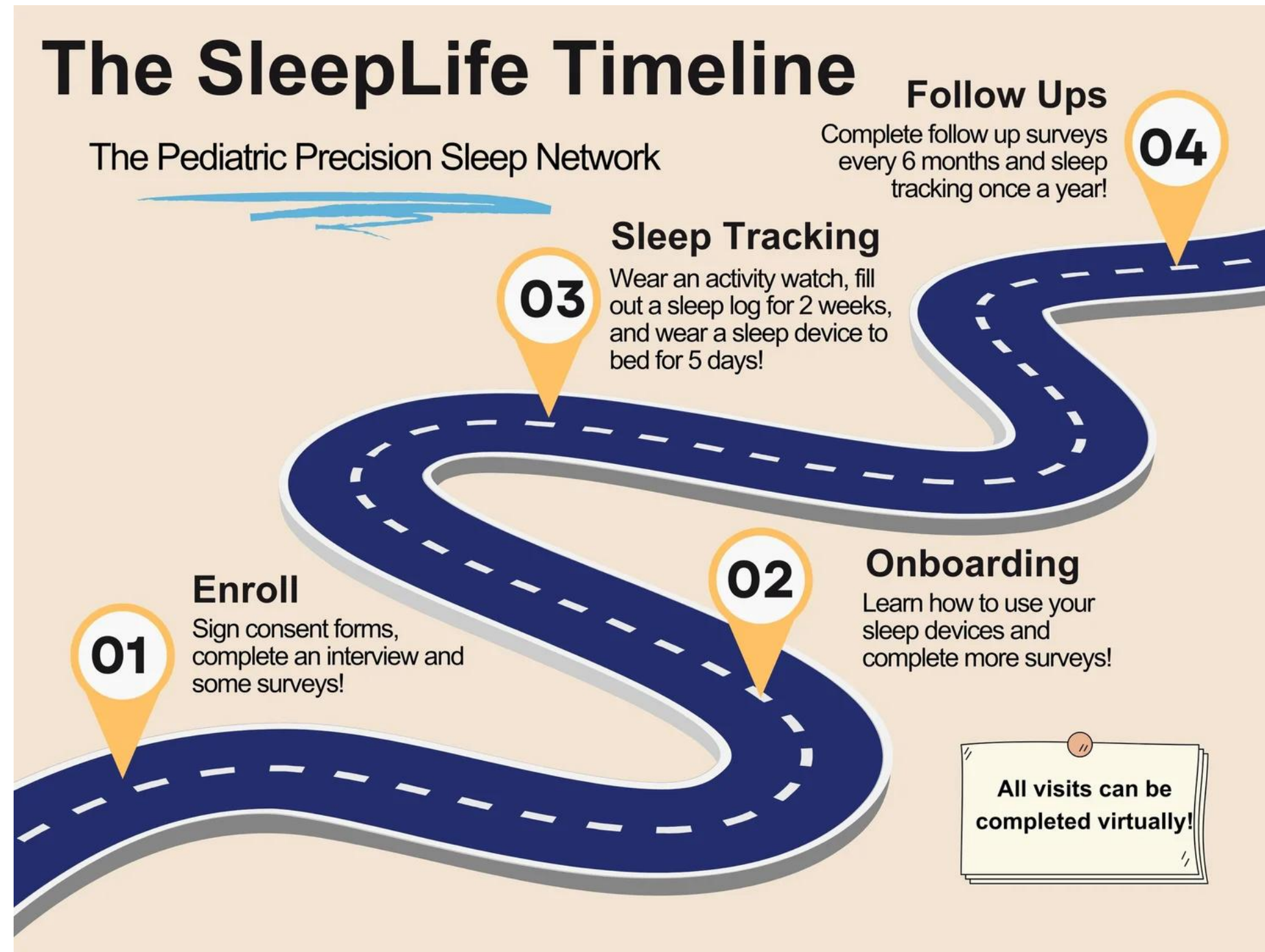


Community Advisory Board
(Providers & Families)



Natural Language
Processing Project
(Archival EHR)

SleepLife Participants



- ✓ **N=1200 youth ages 10-13 years old (n=400 per site)**
- ✓ Engaged in primary care with a recent 'Well Child' visit and approves health record access
- ✓ No major psychiatric diagnosis; serious/unstable medical illness; major sleep disorder; or neurodevelopmental difficulties that impact study feasibility

SleepLife Study Flow



INTAKE

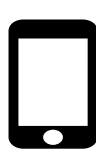
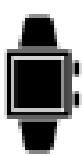
 **Eligibility Evaluation:** Consent/Assent, eligibility screen



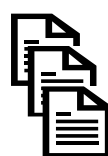
BASELINE

 **Onboarding:** Review sleep tracking, install mobile apps, online surveys

WK1



WK2



Home sleep monitoring for two weeks



FOLLOW-UP

 **Every 6-months:** Online survey battery, electronic health records pulled

 **Every 12-months:** Repeat Baseline Procedures (up to 3 years)

SleepLife Sleep Measures



Sleep Log

Daily survey about sleep completed each morning.



Wrist Activity Monitor

Watch worn to track activity and environmental light levels.



Sleep Recording Device

Forehead device that measures brain waves and movement.



Smartphone Application

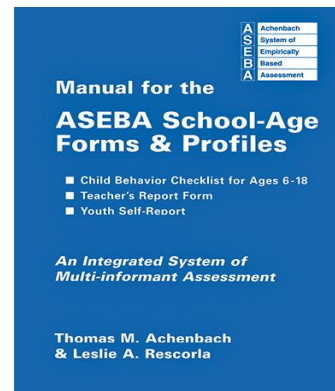
App that tracks movement and phone usage.



Surveys

Series of questions about emotional health, sleep, and other related topics

SleepLife Mental Health Outcomes



Child Behavior Checklist/Youth Self Report for primary transdiagnostic mental health outcome

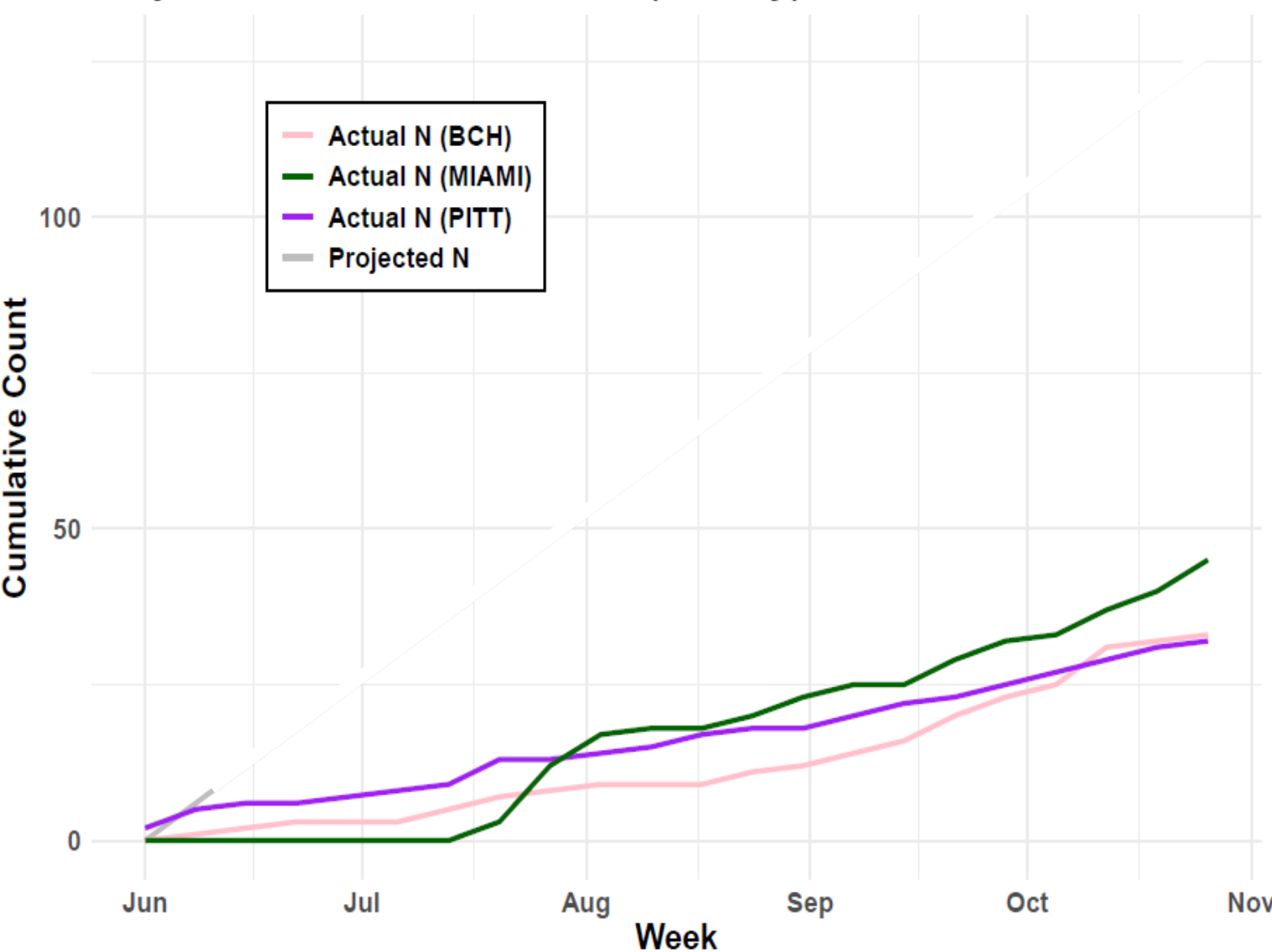


PROMIS Surveys (Pediatric, Parent) for mental health, sleep, social and functional outcomes

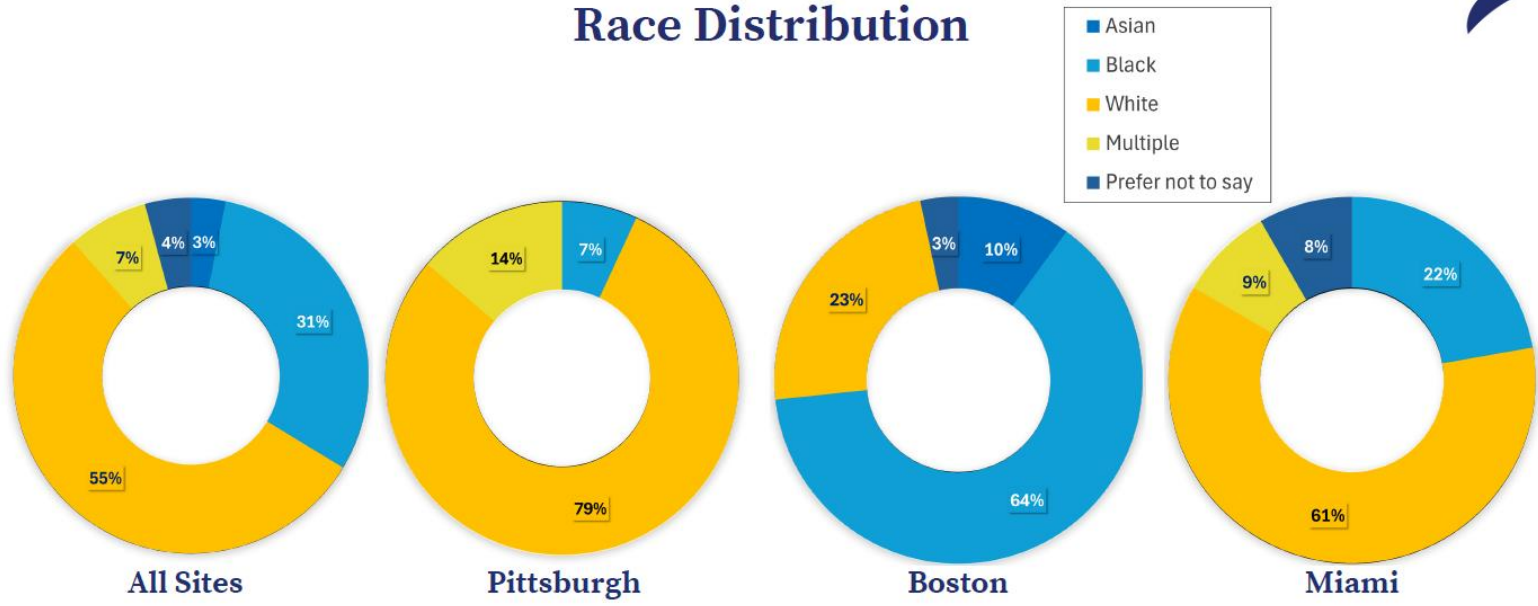
SleepLife Enrollment



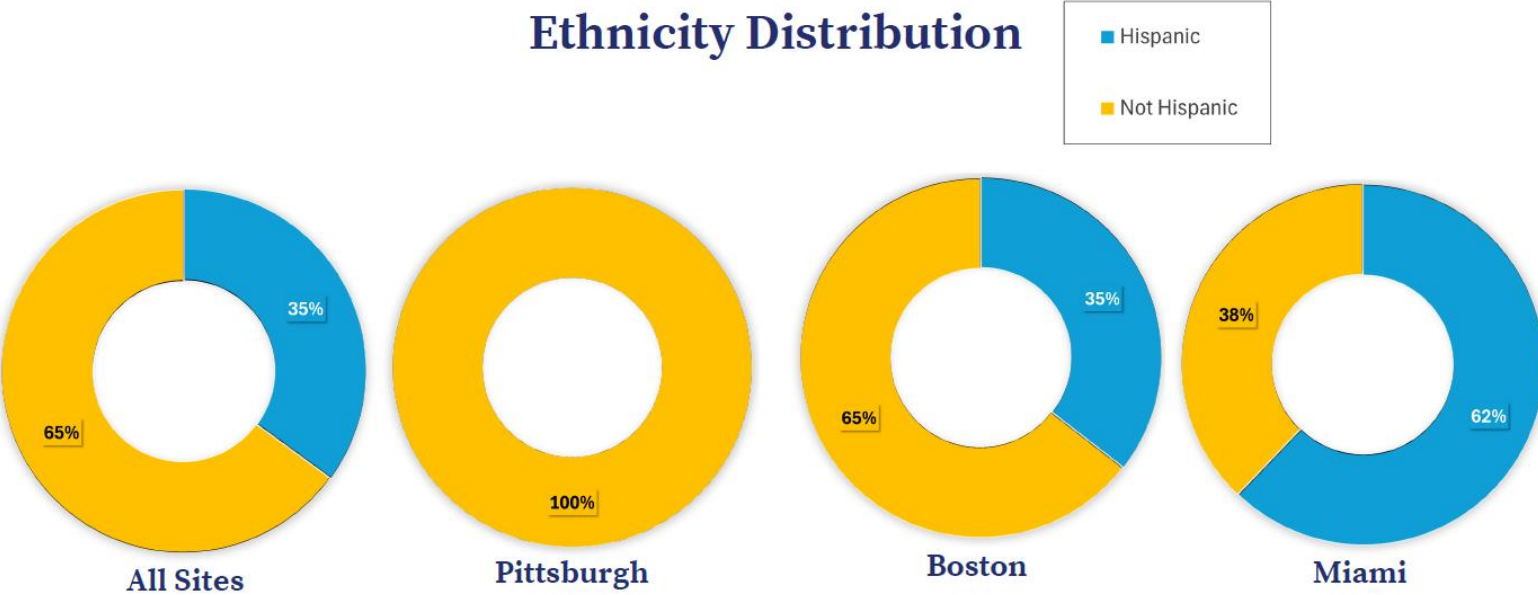
Projected vs Actual Consents (Weekly)



Race Distribution



Ethnicity Distribution

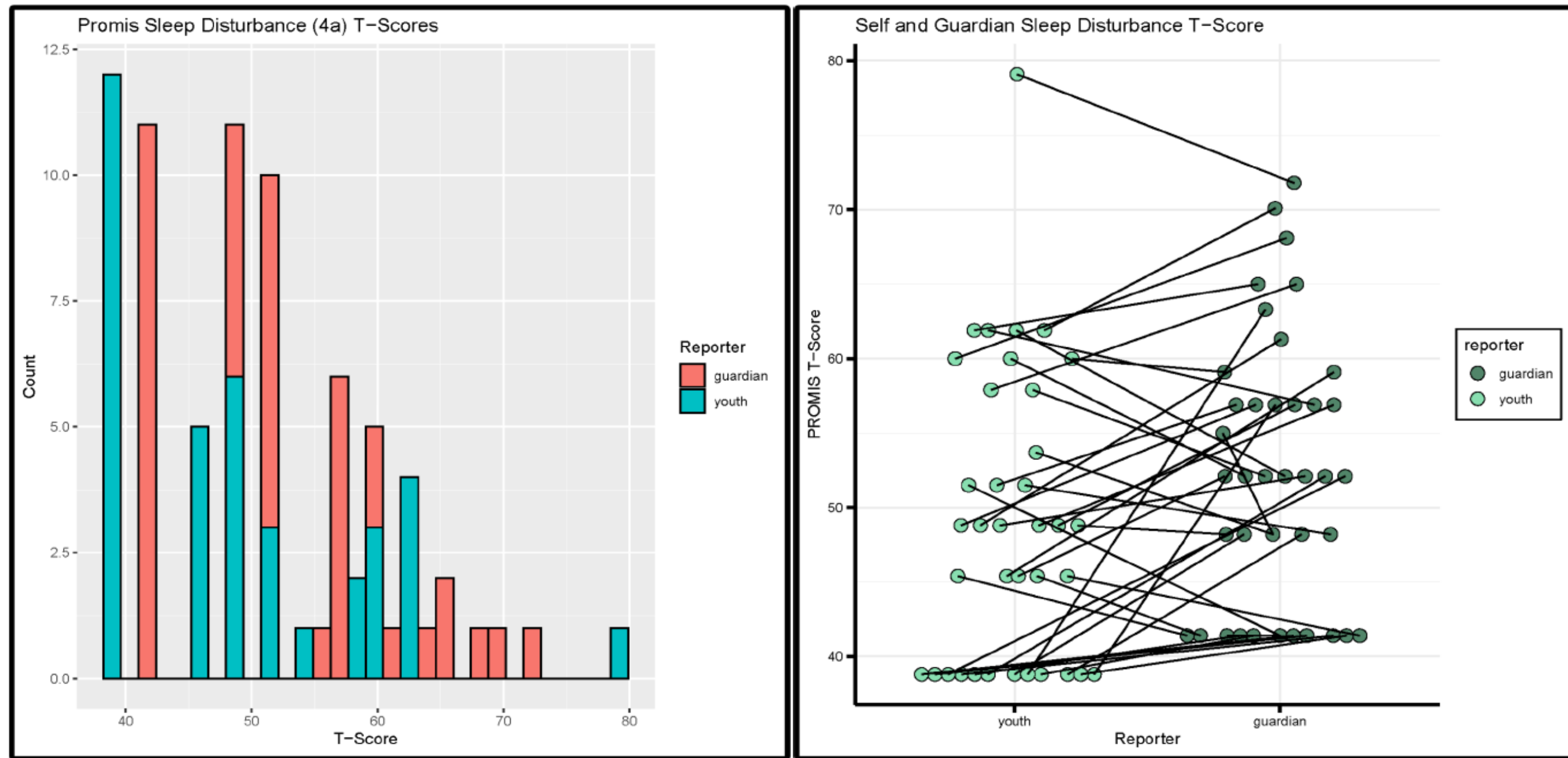


Success

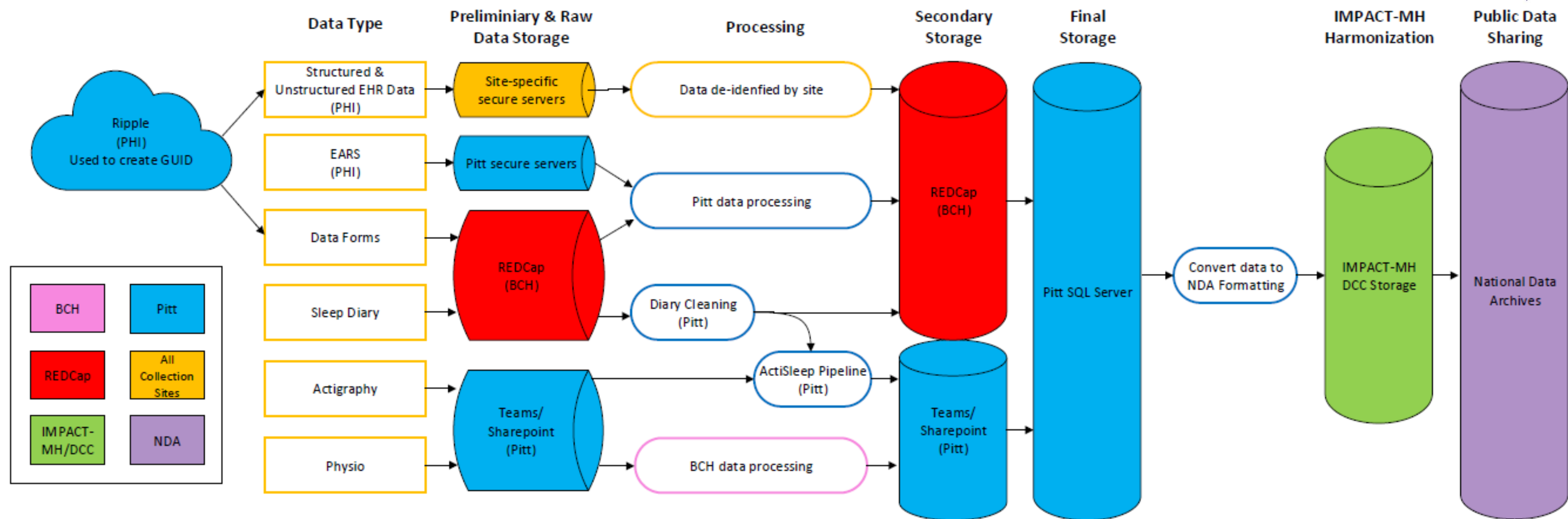
Enrollment is underway at all sites!
(in both English and Spanish)

Challenge

Delay in enrollment start, but we're catching up!



Data Management Workflow



Success

Established data management, processing, and sharing workflow, as well as internal data request process

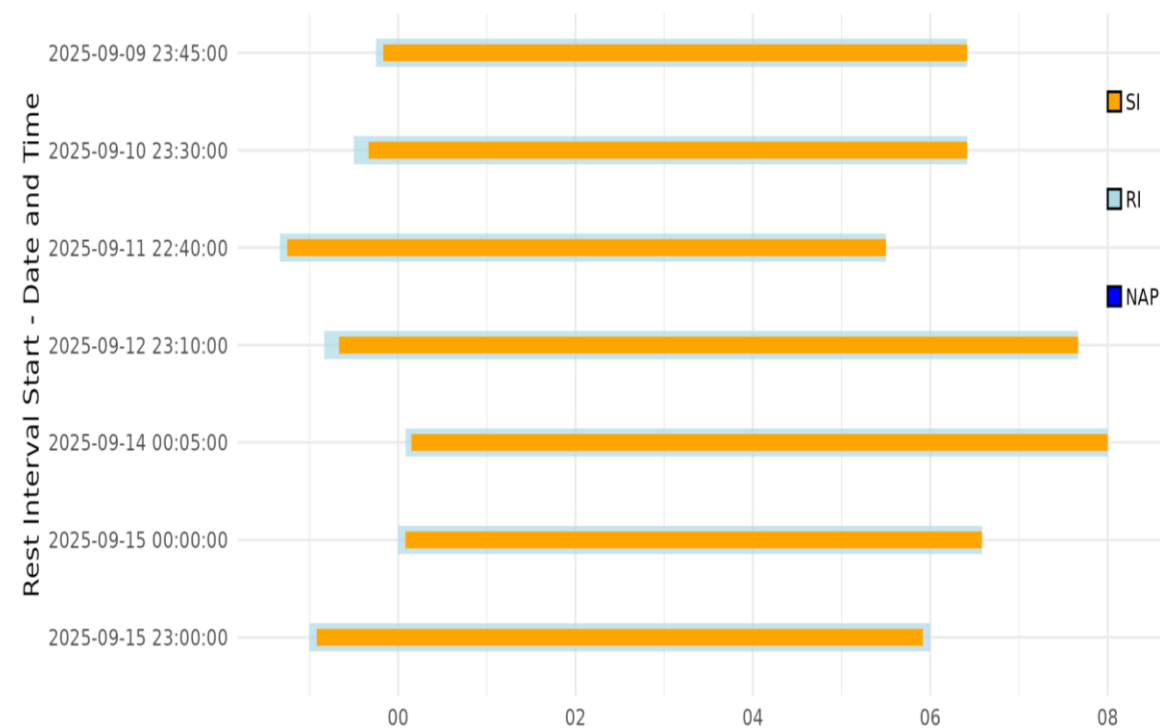
Challenge

Balancing our study efforts with IMPACT-MH harmonization goals

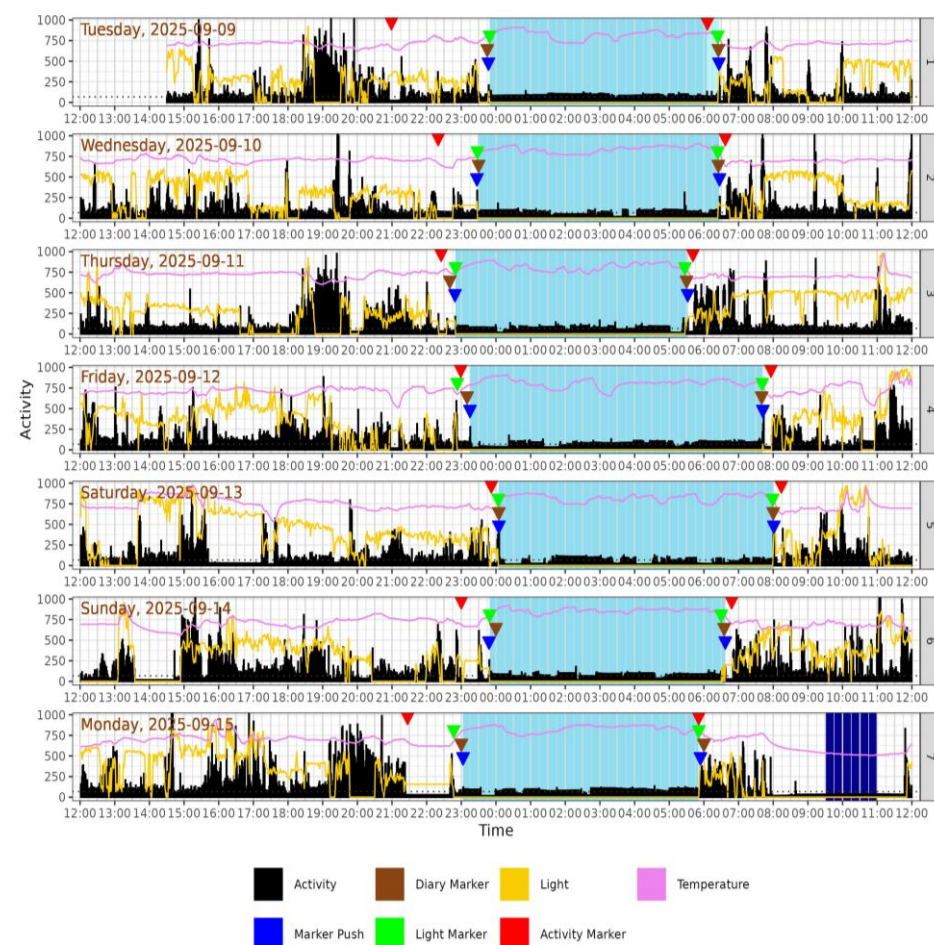
Sleep Data Processing



Sleep Diary

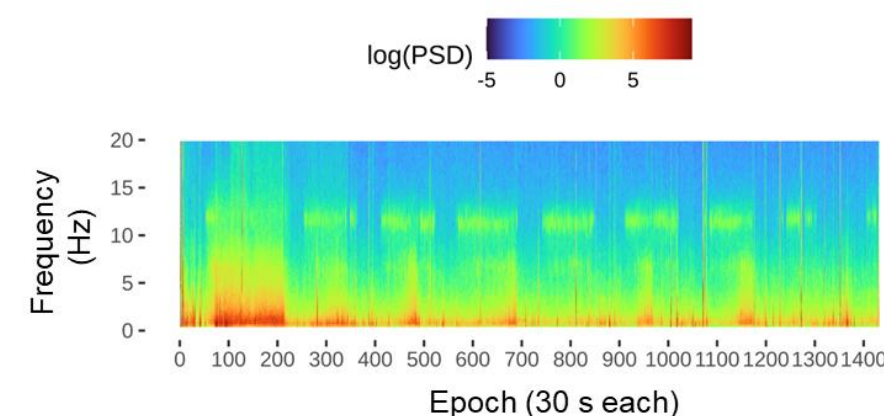


Actigraphy

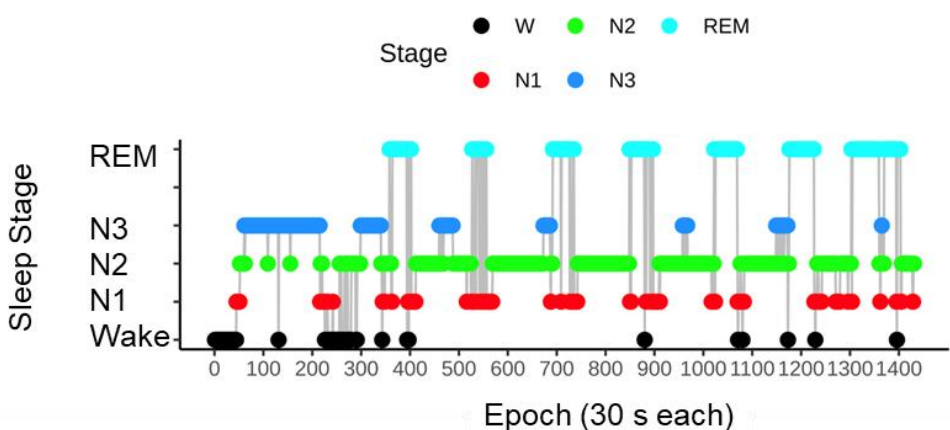


Sleep EEG

Full-Night Spectrogram



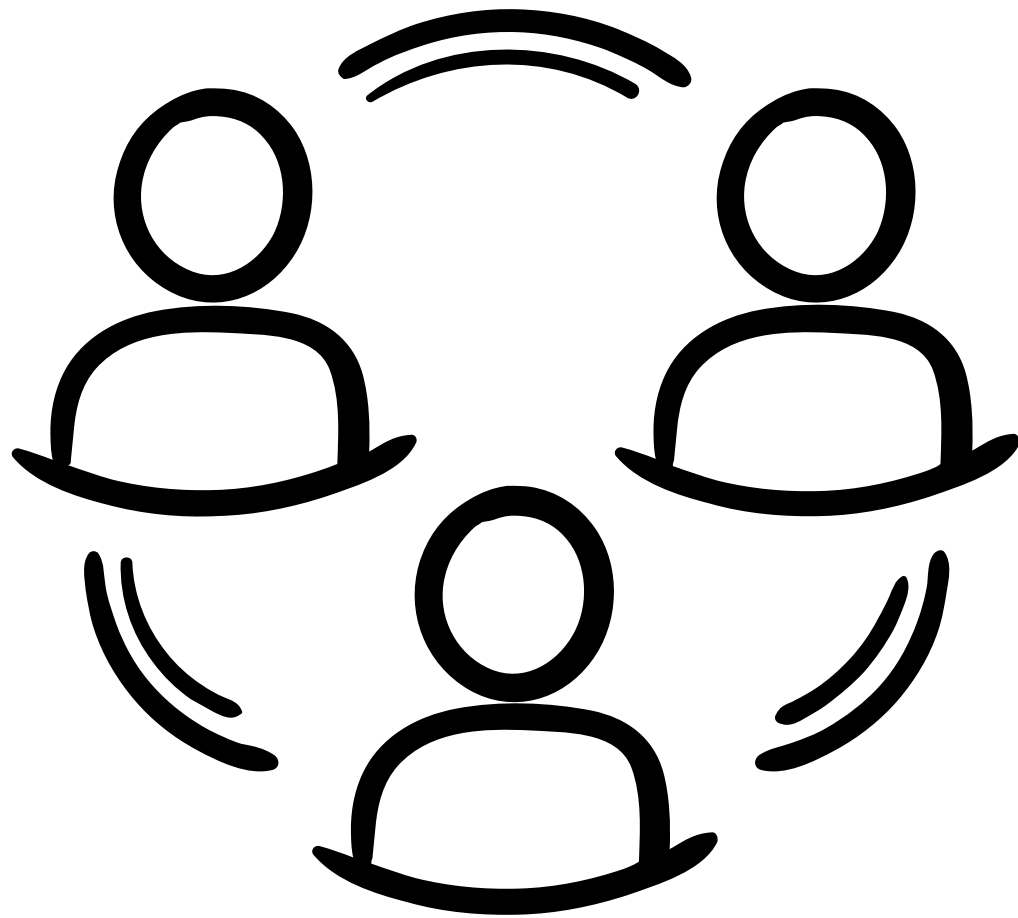
Hypnogram



Success

Established efficient semi-automated pipelines for sleep diary, EEG, and actigraphy

Community Advisory Board



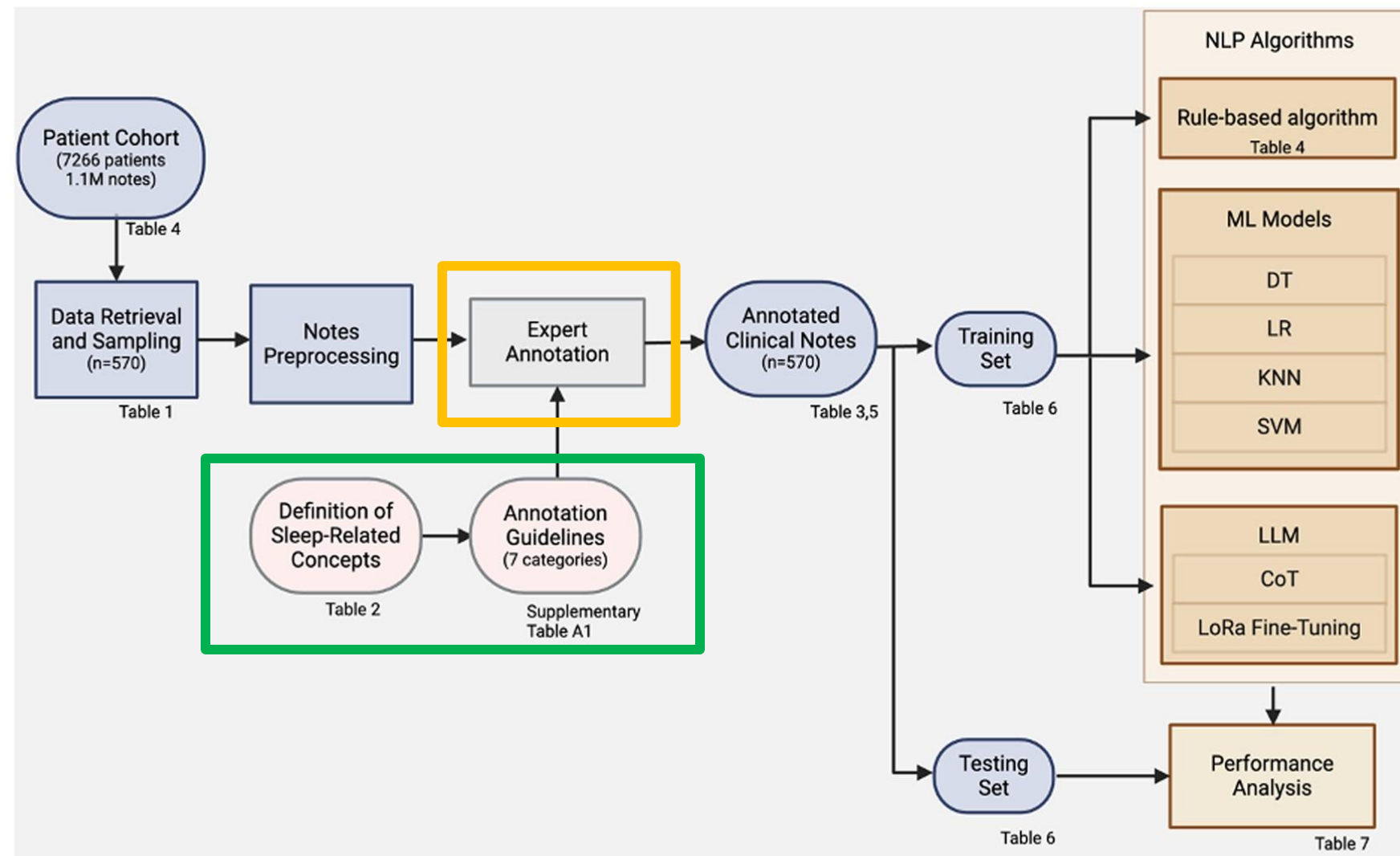
Success Two multi-site provider and two family board meetings

- ✓ How to build trust in the community
- ✓ How to enhance recruitment and study procedures
- ✓ Privacy and safety logistics for a fully remote study
- ✓ Ways to give back to providers and families

Challenge Scheduling, payment logistics



nlp4sleep Algorithm Adaptation



Wang et al, *JAMIA* 2024; 31(10):2217-2227

nlp4sleep is a rule-based algorithm that identifies sleep-related concepts from clinical notes using the OHNLP MedTagger framework (<https://github.com/OHNLP/nlp4sleep>) initially developed for Alzheimer's disease

Success

Established initial annotation guidelines, adapting nlp4sleep for pediatric multi-dimensional sleep health framework

Challenge

... Establishing annotation guidelines.

PPSN Ongoing Projects



Sleep health dimensions from wearables and transdiagnostic mental health outcomes

- **Lead author:** Rebecca Cooper (BCH)
- **Senior author:** Meredith Wallace (PIT)
- **Data:** Adolescent Behavior Cognition Development Study (ABCD)
- **Progress:** Paper written; to be submitted to this month

PPSN Protocol Paper

- **Lead author:** Amanda Baker (FIU)
- **Senior author:** Adriane Soehner (PIT)
- **Data:** N/A
- **Progress:** Paper drafted; to be submitted

EHR Sleep and Mental Health Outcomes in Adolescence

- **Lead author:** Sunah Choi (BCH)
- **Senior author:** Maria Jalbrzikowski (BCH)
- **Data:** BCH Electronic health record data
- **Progress:** Analyses in progress, poster presented at Folkman Research Day 2025 at BCH

Flexible Model-based Clustering on Mixed-type Data: A Study on Children's Sleep Health

- **Lead author:** Quoc Luong Huynh (SJSU)
- **Senior Author:** Meredith Wallace (PIT)
- **Data:** Cleveland Children's Sleep Health Study
- **Progress:** Paper revision in process, to be resubmitted

PPSN Looking Forward

Challenges:

- Optimal stewardship of resources (including funding) in a time of changing NIH policies and procedures

Next Steps in Year 2:

- Continue SleepLife baseline enrollment and begin follow-up phase, interim analyses, finalize nlp4sleep algorithm, expand Community Advisory Board meetings, continue to coordinate with DCC and IMPACT-MH Network



Thank you for your time!

Questions?

